freqrir

Release 0.1

Jesse Wood

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CONTENTS:

Generate a room impuse response in the frequency domain.

CHAPTER

ONE

HOME

1.1 Time domain

Plot a typical impulse repsonse for a room 80 x 12 x 100 sample lengths long. Wall reflection coefficients were all 0.9, ceiling and floor coefficients were 0.7. Source and receiver were at (30, 100, 40) amd (50, 10, 60) sample periods [1].

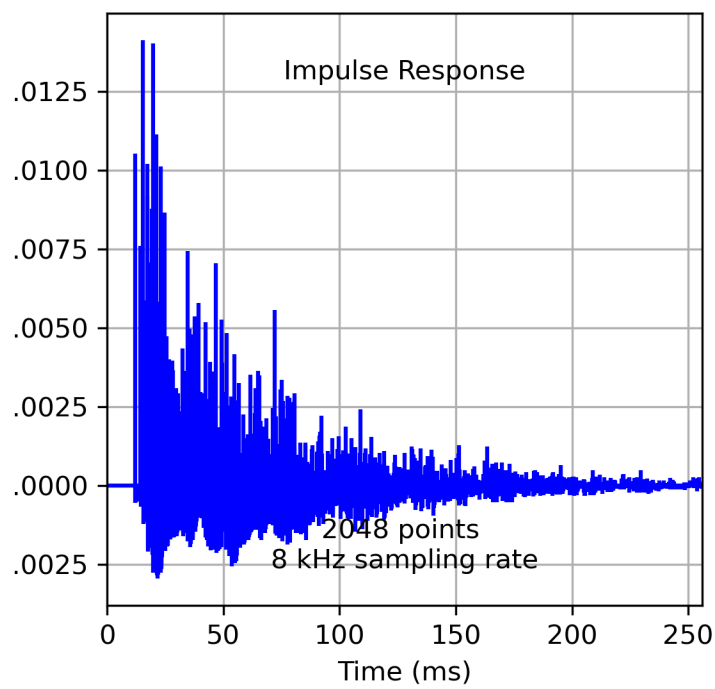

Fig. 1: Room impulse repsonse in time-domain

1.2 Installation

The python libraries necessary ro run this can be installed using `pip` as follows

```
$ pip install .
$ pip install -r requirements.txt
```

1.3 Testing

The unit tests are located in the `tests` directory, they can be run from the root directory

```
$ python -m unittest discover -s tests
```

1.4 References

1. Allen, J. B., & Berkley, D. A. (1979). Image method for efficiently simulating small-room acoustics. The Journal of the Acoustical Society of America, 65(4), 943-950. Available
2. Lehmann, Eric A., and Anders M. Johansson. "Prediction of energy decay in room impulse responses simulated with an image-source model." The Journal of the Acoustical Society of America 124.1 (2008): 269-277. Available

CHAPTER

TWO

FREQRIR

2.1 freqrir module

`freqrir.freqrir.`**`frequency_rir`**(*receivers*, *source*, *room_dimensions*, *betas*, *points*, *sample_frequency*, *frequency*, *c=304.8*, *T=0.0001*, *order=- 1*)

Calculate room impulse response in the frequency domain.

Parameters

- **receiver** (*list[float] with shape (3,)*) – Reciever location in sample periods (s).
- **source** (*list[float] with shape(3,)*) – Source location in sample periods (s).
- **room_dimensions** (*list[float] with shape (3,)*) – Room dimensions in sample periods (s).
- **betas** (*float np-array with shape (3,2)*) – Absorbtion coefficients. Walls: left, right, front, back, floor, ceiling.
- **points** (*int*) – Number of points, which determines precisions of bins.
- **sample_frequency** (*float*) – Sampling frequency or sampling rate (Hz).
- **frequency** (*float*) – Frequency of interest (Hz).
- **c** (*float, optional*) – Speed of sound (m/s). Defaults to 304.8 m/s (i.e. 1 ft/ms) (Allen 1979).
- **T** (*float, optional*) – Sampling period (s). Defaults to 1E-4 s (i.e. 0.1 ms) (Allen 1979).
- **order** (*int, optional*) – Maximum order of reflections. Defaults to -1 (i.e. all reflections).

Returns A pressure wave in the frequency domain.

Return type pressure (complex)

Raises **ValueError** – If source and receiver are too close together (i.e. within 0.5 sampling periods).

2.2 helper module

`freqrir.helper.`**`distance_for_permutations`**(*receiver*, *source*, *room_dimensions*, *vector_triplet*)

Computes the distances between the reciever and the eight image source permutations.

Parameters

- **receiver** (*list[float]*) – Reciever position.
- **source** (*list[float]*) – Source position.
- **room_dimensions** (*list[float]*) – Room dimensions.
- **vector_triplet** (*list[float]*) – Vector triplet (n,l,m) (Allen 1979).

Returns The distances between the reciever and the eight image source permutations.

Return type distances (list[float] with shape (8,))

Examples

```
>>> distance_for_permutations(np.array([0,0,0]), np.array([1,1,1]), np.array([5,5,
↪5]), np.array([0,0,0]))[0]
1.7320508075688772 # Take the first element of the list.
```

`freqrir.helper.`**`distance_from_offset`**(*r*, *offset=[0, 0, 0]*)

Compute the distances for the reciever locations from the offset.

This method generates a density plot for the distances from the offset. The purpose of this method is to verify that the distances are being generated with a uniformly distributed magnitude from the offset (i.e. the center of the point cloud).

Parameters

- **r** (*Array-like*) – Array of reciever locations.
- **offset** (*list[float]*) – Offset from origin for center of point cloud. Default is [0, 0, 0] (origin).

Returns Array of distances.

Return type d (Array-like)

`freqrir.helper.`**`meters_to_sample_periods`**(*x*, *sample_rate*, *c=304.8*)

Convert a measurement from meters to sample periods.

Parameters

- **x** (*float*) – A measurement in meters (m).
- **c** (*float*) – Speed of sound (m/s). Defaults to 304.8 m/s (i.e. 1 ft/ms).
- **T** (*float*) – Sampling period (s). Defaults to 1E-4 s (i.e. 0.1 ms).

Returns A measurement in sample periods (s).

Return type x (float)

Examples

```
>>> meters_to_sample_periods(3.048, 8000) # 1.2 meters (m)
80 # sample periods (s)
```

`freqrir.helper.`**`plot_frequency_rir`**(*rir*, *points*, *frequency*, *save=None*)

Plot room impulse repsonse in the frequency domain.

Parameters

- **rir** (*list[complex]*) – A pressure wave in the frequency domain.
- **points** (*int*) – The number of points.
- **frequency** (*int*) – Sampling rate (Hz)
- **save** (*str, optional*) – Path to save file to. Defaults to None.

`freqrir.helper.`**`plot_recievers`**(*r*, *projection='2d'*)

Plot the reciever locations.

Parameters

- **r** (*Array-like*) – Array of reciever locations.
- **projection** (*str*) – Projection of the reciever locations. Default is 2d.

`freqrir.helper.`**`plot_time_rir`**(*rir*, *points*, *f*, *rt60*, *save=None*)

Plot room impulse repsonse in the time domain.

Parameters

- **rir** (*list[complex]*) – A pressure wave in the frequency domain.
- **points** (*int*) – The number of points.
- **rt60** (*float*) – The reverberation time (RT60) of the room.
- **f** (*int*) – Sampling rate (Hz)
- **save** (*str, optional*) – Save the plot to a file.

`freqrir.helper.`**`sample_period_to_feet`**(*x*, *sample_frequency*, *c=1000*)

Convert a measurement from sample periods to meters.

Parameters

- **x** (*float*) – A measurement in sample periods.
- **sample_frequency** (*int*) – Sampling rate (Hz).
- **c** (*float, optional*) – Speed of sound (ft/s). Defaults to 1000 ft/ms (i.e. 304.8 m/s SI).

Returns A measurement in meters (feet).

Return type x (float)

Examples

```
>>> sample_period_to_feet(80,8000) # 80 sample periods (s)
10 # ft
```

`freqrir.helper.`**`sample_period_to_meters`**(*x*, *sample_rate*, *c=304.8*)

Convert a measurement from sample periods to meters.

Parameters

- **x** (*float*) – A measurement in sample periods.
- **sample_rate** (*int*) – Sampling rate (Hz).
- **c** (*float*) – Speed of sound (m/s). Defaults to 304.8 m/s (i.e. 1 ft/ms).

Returns A measurement in meters (m).

Return type x (float)

Examples

```
>>> sample_period_to_meters(80, 8000) # 80 sample periods (s) at 8 kHZ
3.048 # meters (m)
```

`freqrir.helper.`**`sample_random_receiver_locations`**(*n*, *radius*, *offset=[0, 0, 0]*)

Sample a random reciever location from within a spherical point cloud.

Parameters

- **n** (*int*) – number of receiver locations to sample.
- **radius** (*float*) – radius of the point cloud.
- **offset** (*list[float], optional*) – offset from origin for center of point cloud. Default is [0, 0, 0] (origin).

Returns Array of reciever locations.

Return type r (Array-like)

2.3 timerir module

`freqrir.timerir.`**`high_pass_filter`**(*pressures*, *points*, *sample_frequency*)

High-pass digital filter to wierd behaviour at low frequencies (i.e. 100 Hz).

Parameters

- **pressures** (*list[complex]*) – Pressure wave in the time domain.
- **points** (*int*) – The number of points.
- **sample_frequency** (*float*) – Sampling frequency or sampling rate (Hz).

Returns Pressure wave with frequencies below cutoff removed.

Return type pressures (list[complex])

`freqrir.timerir.time_rir(receivers, source, room_dimensions, betas, points, sample_frequency, order=- 1, c=304.8)`

Calculate room impulse response in the time domain.

Parameters

- **receivers** (*list[list[float]] with shape (N,3)*) – Reciever location(s) in sample periods (s).
- **source** (*list[float] with shape(3,)*) – Source location in sample periods (s).
- **room_dimensions** (*list[float] with shape (3,)*) – Room dimensions in sample periods (s).
- **betas** (*float np-array with shape (3,2)*) – Absorbtion coefficients. Walls: left, right, front, back, floor, ceiling.
- **points** (*int*) – Number of points, which determines precisions of bins.
- **sample_frequency** (*float*) – Sampling frequency or sampling rate (Hz).
- **c** (*float, optional*) – Speed of sound (m/s). Defaults to 304.8 m/s (i.e. 1 ft/ms) (Allen 1979).

Returns A pressure wave in the time domain.

Return type pressures (list[complex])

Raises **ValueError** – If source and receiver are too close together (i.e. within 0.5 sampling periods).

`freqrir.timerir.time_rir_slow(receiver, source, room_dimensions, betas, points, sample_frequency, c=304.8)`

Calculate room impulse response in the time domain.

Parameters

- **receiver** (*list[float] with shape (3,)*) – Reciever location in sample periods (s).
- **source** (*list[float] with shape(3,)*) – Source location in sample periods (s).
- **room_dimensions** (*list[float] with shape (3,)*) – Room dimensions in sample periods (s).
- **betas** (*float np-array with shape (3,2)*) – Absorbtion coefficients. Walls: left, right, front, back, floor, ceiling.
- **points** (*int*) – Number of points, which determines precisions of bins.
- **sample_frequency** (*float*) – Sampling frequency or sampling rate (Hz).
- **c** (*float, optional*) – Speed of sound (m/s). Defaults to 304.8 m/s (i.e. 1 ft/ms) (Allen 1979).

Returns A pressure wave in the time domain.

Return type pressures (list[complex])

Raises **ValueError** – If source and receiver are too close together (i.e. within 0.5 sampling periods).

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CHAPTER

FOUR

CONTACT

Questions? Please contact j.r.h.wood98@gmail.com

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FIVE

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